turning the direction of the semi-solidified slurry once into a horizontal direction; and then

injecting the semi-solidified slurry into molding plates opening/closing in a horizontal direction.

Please add new Claim 25.

25. (New) An injection molding apparatus for a light metal alloy, comprising:

a chamber;

an extrusion screw located substantially vertically and provided rotationally inside said chamber;

a cooling unit for cooling a light metal material in said chamber so as to be formed into a molten metal or semi-solidified slurry;

a connection member having a first internal channel substantially in a vertical direction and a second internal channel extending horizontally from the lower end of the first channel, said connection member being connected to a discharge port of said chamber;

a nozzle connected at the discharge end of said connection member; and

a clamping device for injection molding the molten metal or the semi-solidified slurry discharged from said nozzle, wherein said clamping device is adapted to open or close a movable plate relative to a stationary plate in a horizontal direction.

REMARKS

Favorable consideration of the present application is respectfully requested.

A request for continued examination is being filed herewith.

Claim 1 has been cancelled in favor of new Claim 25. Claim 25 recites an injection molding apparatus for a light metal alloy, including a substantially vertical extrusion screw

and a clamping device adapted to open or close a movable plate relative to a stationary plate in a horizontal direction.

In the injection molding of light metal alloys, the alloys are held in a semi-molten state. It has been known to extrude the semi-molten light metal alloys using a vertically oriented screw extruder, but this requires a large vertical space for the extruder. According to a feature of the invention, the light metal alloy is extruded by a substantially vertically oriented screw extruder in order to minimize pore formation, as well as abrasion and deflection of the extrusion screw (see page 17, lines 3-16). On the other hand, since the clamping device into which the molten metal is injected is oriented to open and close horizontally, there is no need to locate the screw extruder at an unnecessarily high level (see page 17, lines 17-25).

Thus, the invention is able to provide the advantages of a vertically oriented screw extruder, without the major disadvantage thereof: an excessive height requirement. The invention accordingly provides a synergistic result, which is evidence of unobviousness (see MPEP §2141; "when present... synergism may point toward non-obviousness;" see also *Bowser v. U.S.*, 156 USPQ 406 (Ct. Cl. 1967)).

Claims 1-9, 17 and 21 were rejected as being obvious over the U.S. patent to Kono in view of Wang et al and Bradley et al. However, the claimed feature of an injection molding apparatus for a light metal alloy having a substantially vertical extrusion screw and a clamping device adapted to open or close in a horizontal direction is not taught in any proper combination of the cited prior art.

Kono is directed to an injection molding apparatus. In the first embodiment, the extrusion barrel is positioned partially upright, but does not contain an extrusion screw. Rather, it simply houses has a mixer 32 cooperating with a piston 45. The second

embodiment (Fig. 3) uses an extrusion screw, but only because it is entirely horizontally disposed.

The Examiner has alleged that those skilled in the art would have found it obvious in view of Wang et al to provide a screw extruder in Kono. However, this would have been contrary to the explicit teachings of Kono.

It is noted that only Figure 1 of Kono provides a chamber having a partially vertical orientation. The paragraph beginning at line 42 of column 3 in Kono describes that this vertical inclination supplies the metal alloy to the accumulating chamber 50 by the force of gravity -- the mixer is described as providing only a mixing effect ("to assure that the ratio of solid and liquid is consistent throughout the metal alloy").

In contrast, a screw extruder is in fact disclosed in Figure 3 of Kono. But as is described in the paragraph beginning at line 32 of column 5 of Kono, in this embodiment the barrel 30 is positioned horizontally:

> Since gravity no longer supplies the force necessary to advance the metal alloy in the thixotropic state flowing in the barrel 30, a plurality of screw elements 34 driven by motor 33 is provided.

Thus, the explicit teaching of Kono is that gravity feed is to be used for a vertical cylinder, and a screw feed is used only in the case of a horizontally oriented cylinder (Figure 3).

It is, of course, well established that the prior art must be considered in its entirety, including disclosures that teach away from the claims. See MPEP §2141.02 and 2145(X)(D)(2). Here, Kono teaches away from the idea of replacing the mixer 32 with a screw extruder in a substantially vertically oriented mixer. Instead, Kono teaches that screw extruders are used only where "gravity no longer supplies the force necessary to advance the metal alloy." Therefore, regardless of the fact that screw extruders exist, *per se*, e.g., in Wang et al, it would not have been obvious for those skilled in the art to have replaced the

mixer of Figure 1 in Kono with a screw extruder. Conversely, it would not have been obvious for those skilled in the art to reorient the horizontal extruder and cylinder of Figure 3 to be vertical.

Bradley et al was only cited to teach a clamping device. Since it would not have been obvious for those skilled in the art to have replaced the mixer 32 of Kono with a screw extruder, no combination of the above references would suggest the subject matter of the claims, regardless of what teaching Bradley et al might have with respect to a clamping device.

Claim 3 further recites that the screw extruder has an injection function of moving the extrusion screw in the axial direction. This is done in Kono by horizontal piston 45, and not by the vertically extending mixer (column 3, lines 58-65). Therefore, even if those skilled in the art were motivated to modify Kono in light of Wang et al to provide a screw extruder in Figure 1 of Kono, which screw extruder has an injection function of moving the extrusion screw in the axial direction, those skilled in the art would replace the piston 45 of Kono with a screw, but not the mixer 32.

Claim 5 is directed to the feature of the invention wherein an injection plunger moving in the horizontal direction is disposed in the second channel, e.g., Figure 3. In contrast, the piston 45 of Kono cannot move into the accumulation chamber 50 (second channel). Therefore, Kono cannot provide the feature of the invention whereby semi-solidified slurry in the second channel can be injected into molding plates by accumulating a predetermined amount of the semi-solidified slurry in the second channel and then projecting the plunger at one time (page 19, lines 7-13 of the specification). Thus, Kono's extruding and injection mechanism is different from that of Claim 5.

Claim 7 recites that the extrusion screw comprises a central shaft rotatably inserted in the chamber and a plurality of screw segments fitted over the outer circumference of the central shaft and arranged in the axial direction. This has the advantage that a damaged segment can be replaced easily (page 6, lines 2-8), and is not disclosed in any of the cited references. While the Examiner has alleged that this is described at lines 6-19 of column 5 in Wang et al, Wang et al has no detailed description of the extrusion screw.

Applicants therefore believe that the claims define over the prior art, and respectfully solicit an early Notice of Allowability.

Respectfully submitted,

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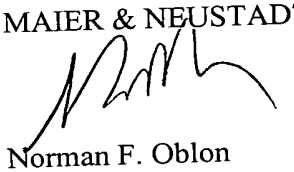

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IN THE CLAIMS

Please amend the claims as follows:

--1. (Cancelled)

2. (Amended) An injection molding apparatus as defined in claim [1] 25, further comprising:

a hopper for storing the molten metal connected to an upper portion of the chamber.

3. (Amended) An injection molding apparatus as defined in claim [1] 25, wherein the screw extruder has an injection function of moving the extrusion screw in the axial direction to inject the molten metal of the semi-solidified slurry.

5. (Amended) An injection molding apparatus as defined in claim [1] 25, wherein the screw extruder has an extrusion screw not moving in the axial direction, and an injection plunger moving in the horizontal direction is disposed in the second channel.

7. (Amended) An injection molding apparatus as defined in claim [1] 25, wherein the extrusion screw comprises a central shaft rotatably inserted in the chamber and a plurality of screw segments fitted over the outer circumference of the central shaft and arranged in the axial direction.

10. (Amended) An injection molding apparatus as defined in claim [1] 25, further comprising:

a static mixer disposed in the nozzle for mixing the semi-solidified slurry passing through the nozzle.

17. (Amended) An injection molding apparatus as defined in claim [1] 25, wherein a slitwise channel is disposed in the nozzle for causing a shearing flow to the semi-solidified slurry passing through the nozzle.

21. (Amended) An injection molding apparatus as defined in claim [1] 25, wherein the chamber comprises a heating unit for heating the material at the inside.

22. (Amended) A method of injection molding a light metal alloy comprising the following steps of:

cooling a molten metal under shearing by an extrusion screw and thereby forming the same into a semi-solidified slurry in a chamber of a light metal alloy injection molding apparatus as defined in claim [1] 25;

discharging the semi-solidified slurry from a discharge port at the lower end of the chamber;

turning the direction of the semi-solidified slurry once into a horizontal direction; and then

injecting the semi-solidified slurry into molding plates opening/closing in a horizontal direction.

Claim 25 (New).--